



The Radio Amateur Satellite Corporation



Richard M. Hambly,
President
W2GPS



AMSAT

AMSAT Annual Meeting

October 27, 2007



AMSAT's Officers for 2007-2008

President	Richard Hambly W2GPS	Severna Park, MD
Executive VP	Lee McLamb KU4OS	Cocoa, FL
VP Operations	Drew Glasbrenner, KO4MA	New Port Richey, FL
VP User Services	Gould Smith, WA4SXM	Knoxville, TN
VP Engineering	Bob McGwier N4HY	East Windsor, NJ
VP Marketing	Lewis D. ("Dan") Briner	Canonsburg, PA
Secretary	Barry Baines WD4ASW	Westborough, MA
Treasurer	Gunther Meisse W8GSM	Mansfield, OH
Manager	Martha Saragovitz	Silver Spring, MD



President's report for 2007

AMSAT's Mission Statement

As of 21-Feb-04

- AMSAT designs, builds and operates experimental satellites and promotes space education.
 - » Non-profit
 - » Volunteer
- Partnerships
 - » Government, industry, educational institutions and fellow amateur radio societies.
- Technical and scientific innovation
- Training and development
 - » Designers and Operators.



President's report for 2007 AMSAT's Vision Statement

As of 21-Feb-04

- Deploy **high earth orbit (HEO) satellites**
 - » Daily coverage
 - » Continuous coverage
- Participation in **human space missions**
- Support a stream of **LEO satellites**
 - » Developed in cooperation with the educational community and other amateur satellite groups.



President's report for 2007 2006-7 Achievements

- SuitSat
- ARIS
 - » New AMSAT ARISS representative, Stefan Wagener VE4NSA
- P3-E; International Cooperation
 - » We at AMSAT-NA are combining financial support with AMSAT-UK with the goal to complete P3E and make flight ready in 2008.
- Eagle Developments
- Educational Outreach
- AO-51 Performance
- HPSDR Alliance
- AMSAT Presence at Major Hamfests/Conferences
- Regulatory Issues
- Expanding the Talent Pool
- National Fund Raising Initiative
- AMSAT Lab Move and Buildout.



President's report for 2007

The Reality of the Future

As of 2007

- New missions will provide great new services to the Ham community but we cannot pay for them.
- No one will pay for more “toys” for us to play with.
- Our missions must excite the funding sources.
- **EDUCATION**
 - » AMSAT Institute
 - » Phase-IV TDRS-like support of ARISS
- **EMERGENCY COMMUNICATIONS**
 - » Phase-IV geosynchronous satellite
 - » Advanced Communications Payload



President's report for 2007 BACKUP SLIDES

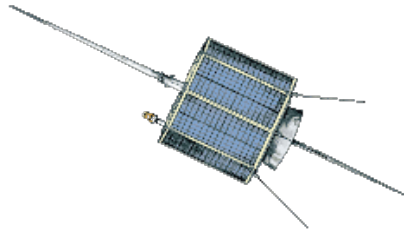


AMSAT is Amateur Radio

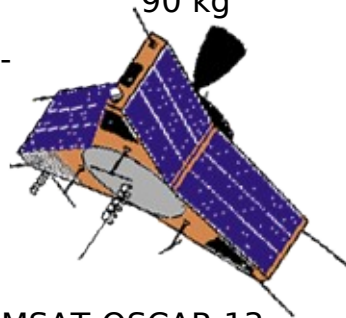
AMSAT is to satellites what the Wright brothers were to flight.



OSCAR 1
Launched 12-Dec-1961
Vandenberg AFB
Agena Rocket
Apogee 431.00 km
Perigee 245.30 km
4.5 kg



AMSAT-OSCAR 7
Launched 15-Nov-1974
Vandenberg AFB
Delta 2310
Apogee 1459 km
Perigee 1440 km
28 kg

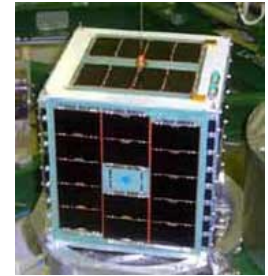


AMSAT-OSCAR 13
Launched 15-June-1988
French Guiana
Ariane 4
Apogee 36077 km
Perigee 2545 km
92 Kg

AMSAT-OSCAR 10
Launched 6-Jun-1983
French Guiana
Ariane 4
Apogee 35465 km
Perigee 3982 km
90 kg



AMSAT-OSCAR 40
Launched 16-Nov-2000
French Guiana
Ariane 5
Apogee 58665.00 km
Perigee 1157.00 km
244.000 Kg



AMSAT-OSCAR 51
Launched 28-Jun-2004
Baikonur
Cosmodrome
Dnepr rocket
Apogee 818 km
Perigee 696 km
11.14 kg

We are “Amateur” only in the sense that we are not paid in much the same sense that Olympic athletes are “Amateurs.”



Amateur Satellites Advance Real Science



OSCAR 5	197 0	First use of passive magnetic stabilization
OSCAR 6	197 2	Codestore (CW Store and Forward) Message System) First satellite-to-satellite relay of communications (See OSCAR 7).
OSCAR 7	197 4	Battery Charge Regulator, Analog Store and Forward of Medical Data, Synthetic High Efficiency Power Amplifier (HELAPS), SARSAT First satellite-to-satellite relay of communications (See OSCAR 6)
OSCAR 11	198 4	Imaging, Dust Impact Detectors, Geiger Counters, Digital Communications
OSCAR 14	199 0	Packet Radio, 9.6K Data Rate, Imaging, Digital Store and Forwarding
OSCAR 23	199 2	Wide and Narrow Imaging, Cosmic Ray detection, radiation dose monitor
OSCAR 24	199 3	2.4GHz S-Band Transponder
OSCAR 25	199 3	Imaging, IR Sensor Experiment
OSCAR 28	199 3	38k4 Digital Link, GPS Experiment, Star Sensor, Cosmic Ray Detection, DSP
OSCAR 34	199 8	Direct Sequence Spread Spectrum
OSCAR 36	199 9	1 MB/Sec Digital, Viterbi encoding
OSCAR 38	200 0	First Automatic Launcher (6 Picosatellites)

October 25, 2000

W2GPS

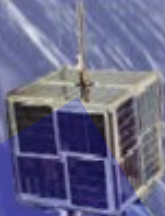


AO-51

Two Years of Great Performance



**AMSAT**TM



850 Sligo Ave. Suite 600
Silver Spring, MD 20910
1-888-322-6728

AO-51 Schedule

[Launch Pad](#) | [Navigator](#) | [Sat Status](#) | [Keps](#) | [Passes](#) | [News](#) | [Store](#) | [Members](#) | [Contact Us](#) | [Return](#)

AO-51 Schedule

Schedule for

▼ Mode / Day* ►	1 S	2 M	3 T	4 W	5 Th	6 F	7 S	8 S	9 M	10 T	11 W	12 Th	13 F	14 S	15 S	16 M	17 T	18 W	19 Th	20 F	21 S	22 S	23 M	24 T	25 W	26 Th	27 F	28 S	29 S	30 M	31 T
Voice Uplink	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
Voice Downlink	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
TL Beacons	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	0	0	0	0	0	0	0	0	U	U	U	U	U	U	U	U
BBS Uplink	V	V	V	V	V	V	V	V	V	V	V	L	L	L	L	L	L	L	L	L	L	L	L	V	V	V	V	V	V	V	V
BBS Downlink	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Uplink Bandwidth	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	0	0	0	0	0	0	0	0	L	L	L	L	L	L	L	L
Downlink Bandwidth	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	0	0	0	0	0	0	0	0	L	L	L	L	L	L	L	L

*Dates in gold are Experimenter's Wednesdays



SuitSat-1

A Spacesuit Floats Free



Dubbed Suitsat-1, the Russian spacesuit was fitted with a transmitter and was pushed out by the space station crew to orbit the Earth.

SuitSat captured the attention of the world and helped promote Amateur Radio.

02-Feb-06



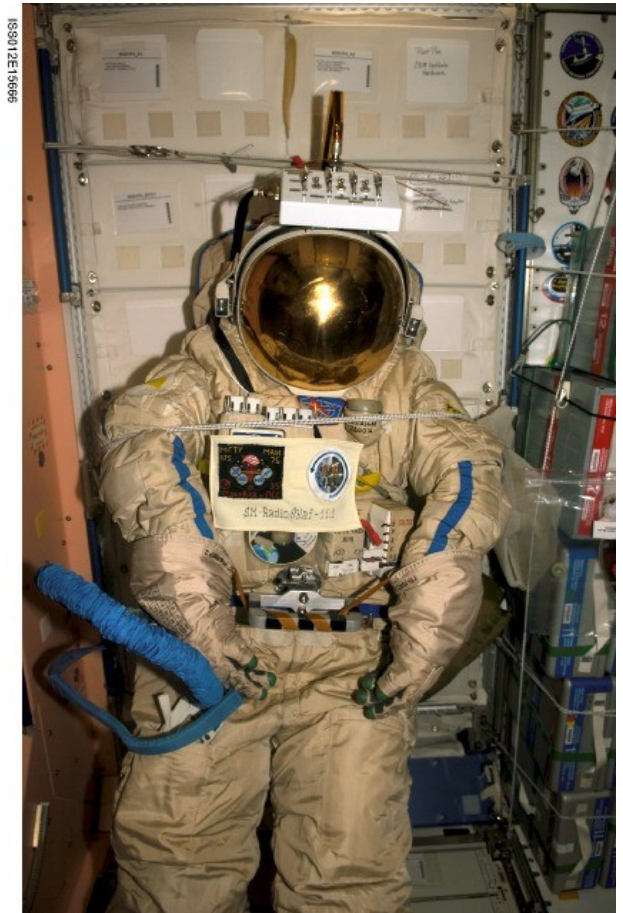


SuitSat-1

Downlink Messages

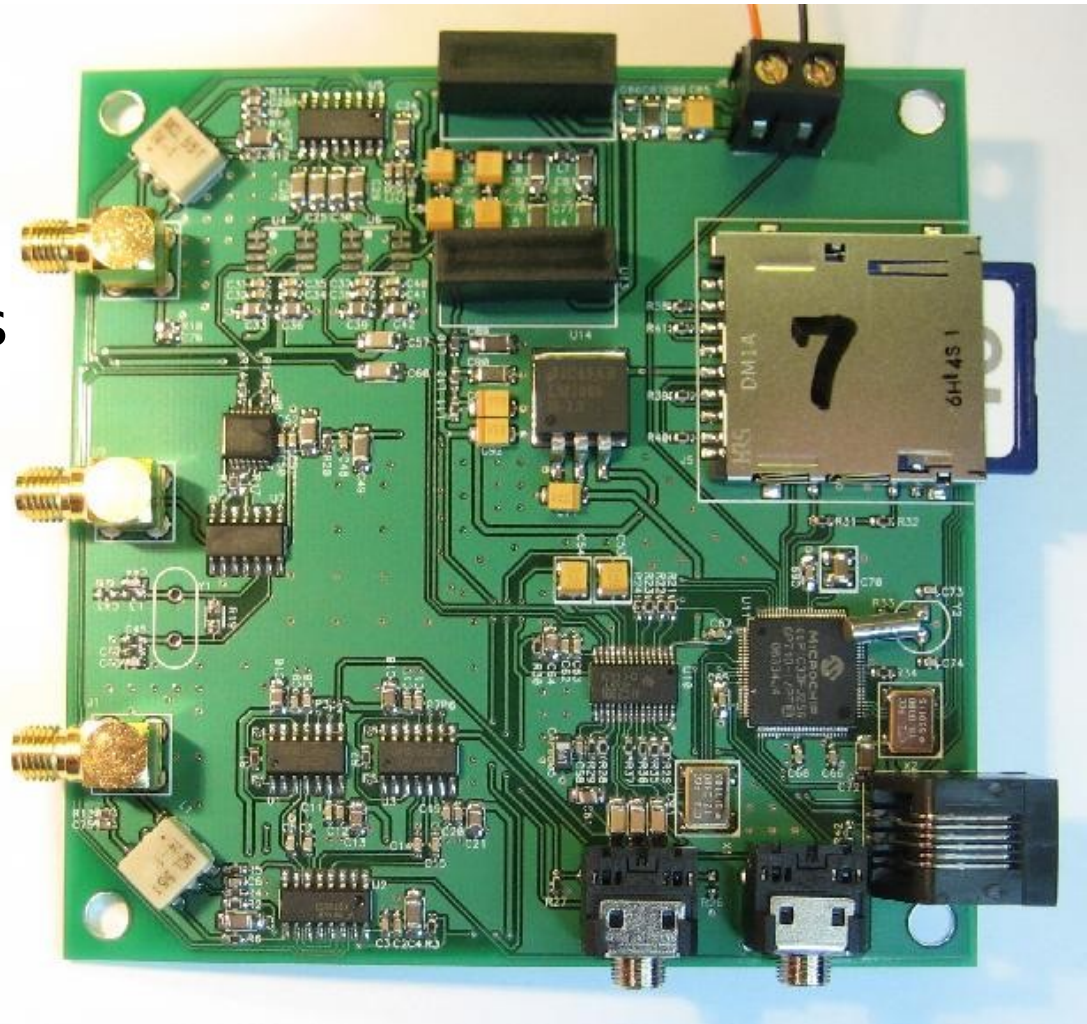


- Voice telemetry (mission time, temperature, battery voltage)
- Russian message
- Europe student message (Spanish & German)
- Bauman Institute message in Russian
- Canada student message in French
- Mr. Alexandrov message in English
- Japan student message in Japanese
- USA student message in English
- SSTV picture transmission



ODYSSEY - Low Power Handheld SDR

- Enable low power, hand-held software defined radio objects to be built.
- Project Odyssey was born at the Johnson Space Center during a design meeting for experiments we hope to be include on SUITSAT-2.
- May provide a comm package for future CubeSats.





ARISS at the 2006 AMSAT Symposium



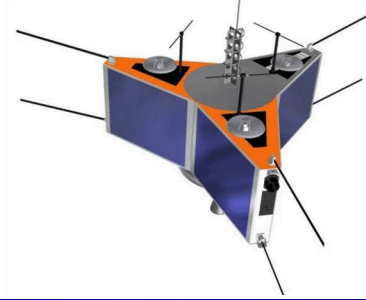
The Keynote Speaker *was*
Expedition 12 Commander
William S. McArthur, Jr.
KC5ACR



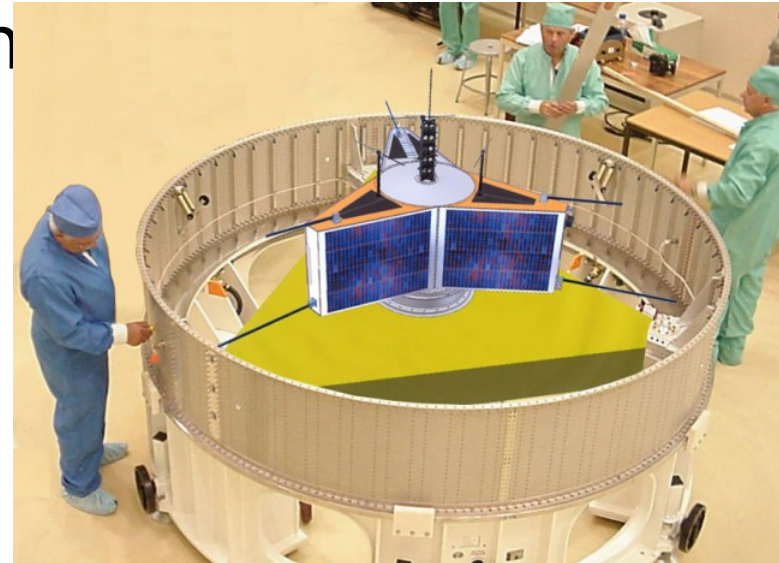


AMSAT P3E

AMSAT-NA Tasks



- On board computer (IHU-3)
- Satellite control bus (CAN-DO)
- Software Defined Transponder (SDX)
- A new, extremely efficient linear amplifier for the transponder
 - » A higher form of “HELAPS” than has ever been flown before





AMSAT P3E

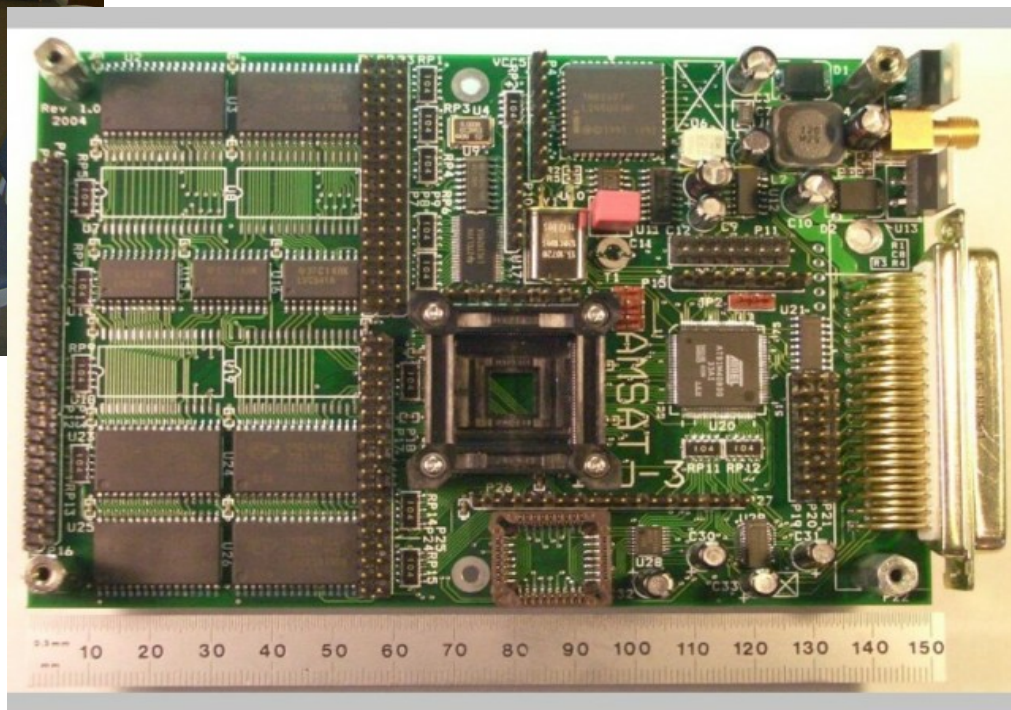
Internal Housekeeping Unit 3 (IHU-3)



AMSAT-NA IHU-3 team
meeting with
Prof. Dr. Karl Meinzer
DJ4ZC in Marburg Germany

On board
computer (IHU-

October 25, 2003)

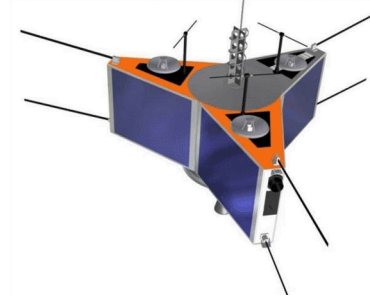


W2GPS



AMSAT P3E

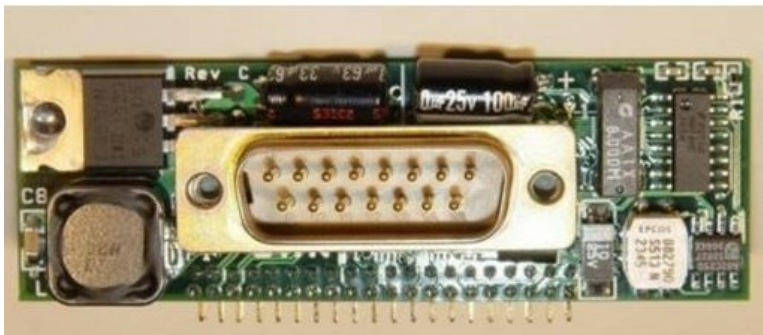
CAN-DO Satellite Bus



- AMSAT-NA Team:
 - » Bdale Garbee, KB0G Project Lead
 - » Chuck Green, N0ADI PCB
 - » Lyle Johnson, KK7P Electrical Design
 - » Stephen Moraco, KC0FTQ Firmware Design and User's Guide Editor
 - » John Conner, NJ0C UHU Design
 - » Stacy Mills, W4SM Radiation Testing



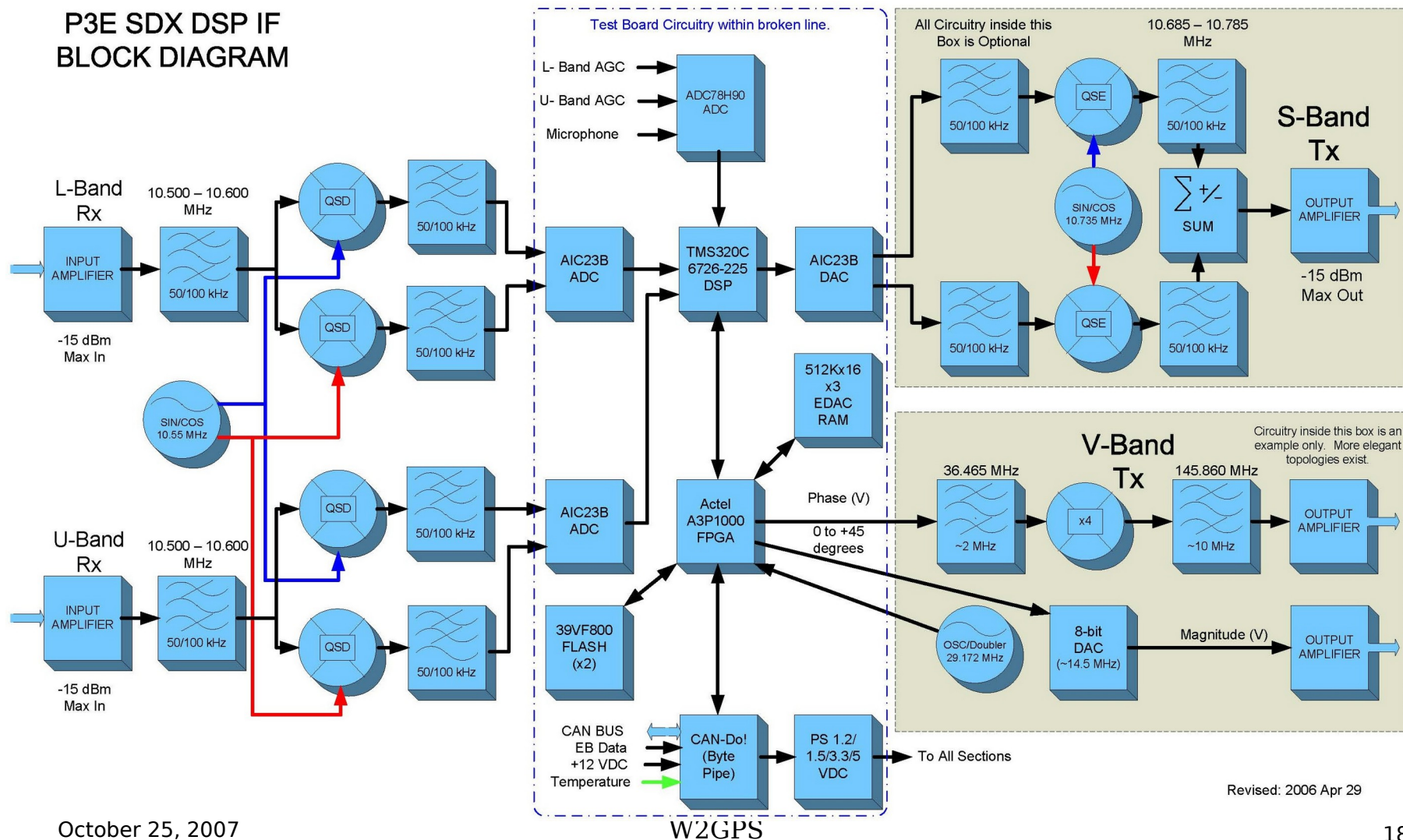
- Successfully passed Radiation testing
 - » with Cobalt60 source and Protons
- 100 Units to be build
 - » for P3-E, P5-A and EAGLE



AMSAT P3E

Software Defined Transponder (SDX)

P3E SDX DSP IF BLOCK DIAGRAM





AMSAT's Next Major Project: Eagle



- Next Generation high earth orbit satellite
 - » Intended orbit: High eccentricity GTO
- Capabilities
 - » Higher frequency microwave bands
 - » Software defined transponders
 - » Improved digital capabilities
 - » Advanced internal housekeeping unit and interconnection bus
- Robust microwave capability to support backpack/jumpbag entry into disaster area for emergency communications -- LDR digital voice, SMS-like text, and MDR data
- Advanced design work and preliminary construction underway
 - » Minimize ground station footprint





Overview

Resources - the Amateur Satellite Service

HF Bands*	29.300 - 29.500 MHz	200 kHz	Primary	Uplink & Downlink
V Band ✓	145.80-146.00 MHz	200 kHz	Primary	Uplink & Downlink
U Band ✓	435.00-438.00 MHz	3 MHz	RR 5.282	Uplink & Downlink
L Band ✓	1260-1270 MHz	10 MHz	RR 5.282	Uplink Only
S Band ✓	2400-2450 MHz 3400-3410 MHz †	50 MHz 10 MHz	RR 5.282 RR 5.282	Uplink & Downlink Uplink & Downlink
C Band	5650-5670 MHz 5830-5850 MHz	20 MHz 20 MHz	RR 5.282 RR 5.282	Uplink Only Downlink Only
X Band	10.45 - 10.5 GHz	50 MHz	Secondary	Uplink & Downlink
K Band	24.0 - 24.05 GHz	50 MHz	Primary	Uplink & Downlink
Q Band	47.0 - 47.2 GHz	200 MHz	Primary	Uplink & Downlink
W Band	76.0-77.5 GHz 77.5 - 78.0 GHz 78.0-81.5 GHz	1500 MHz 500 MHz 3500 MHz	Secondary Primary Secondary	Uplink & Downlink

* There are also HF allocations at 7, 14, 21 and 25 MHz

† 3.4 GHz is available in Region 2 & 3 only

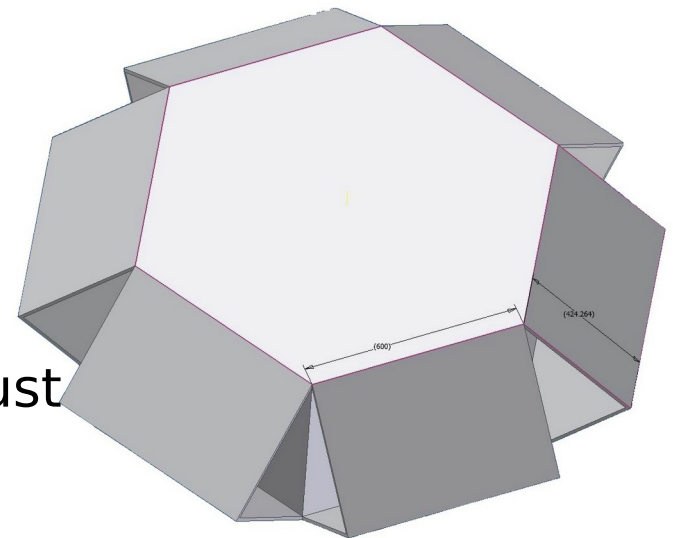
✓ *E Bands proposed for this payload*
✓ *E-S Bands proposed for this payload*



Eagle

Eagle Satellite Project Goals

- A long access time satellite
- Bring communications capability to [those] who cannot use satellites today (ex. CC&R)
- Provide effective communications at frequencies that allow manageable antenna sizes and power levels
- Minimize the need for complex and expensive antenna steering and frequency tracking mechanisms.
- We need solutions that make sense. To underpin the solution set with a robust digital data link is an obvious and appropriate first step.
- Goals set the tone for the design but are not requirements.

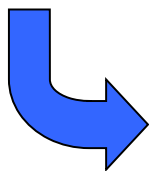




Eagle

EaglePedia at www.amsat.org

EaglePedia

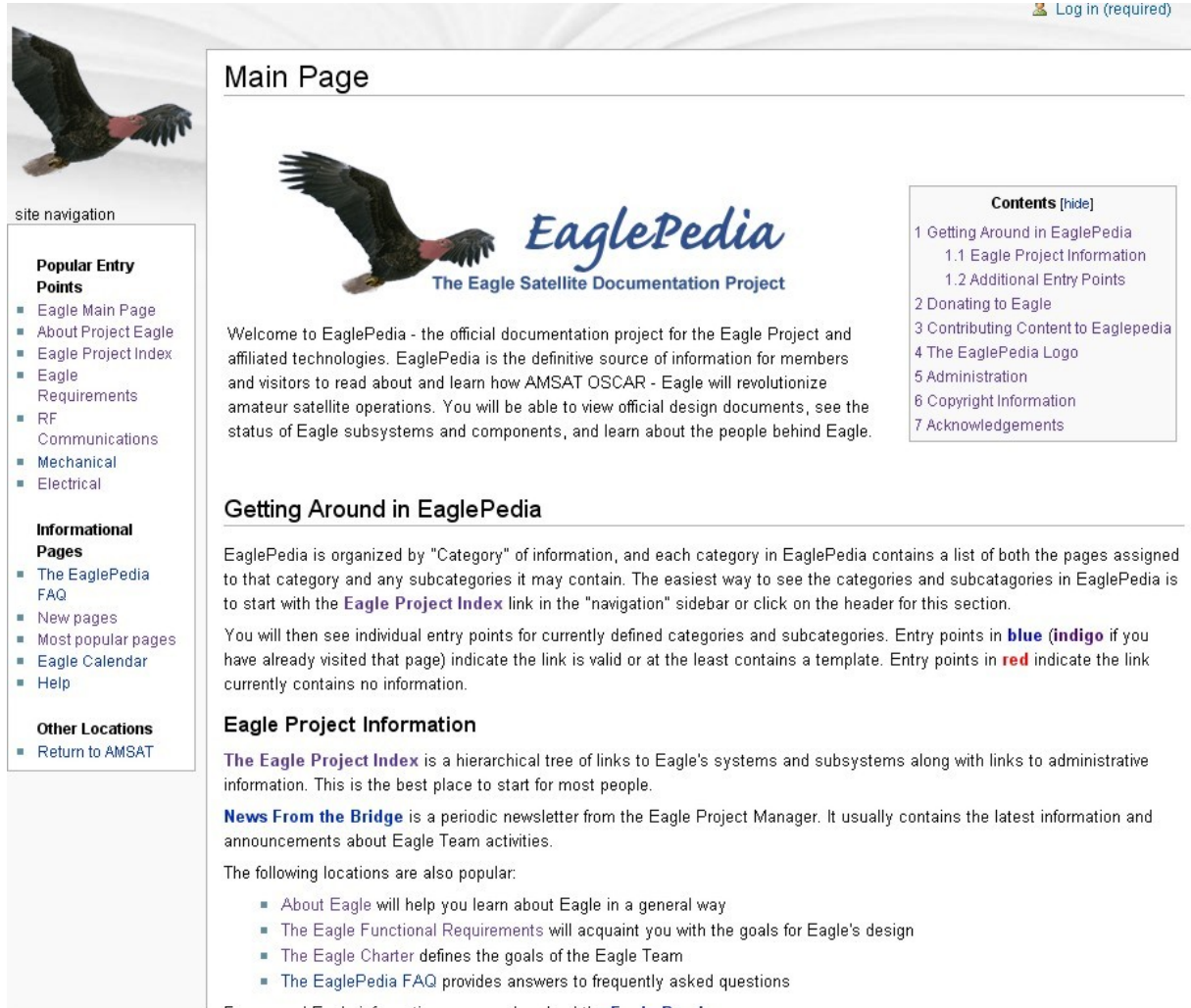


Is now open to public viewing.

This is the open source repository of Eagle design and development information

Some pages are open only to the Eagle team until internal peer reviews are complete.

October 25, 2007



Log in (required)

Main Page



EaglePedia

The Eagle Satellite Documentation Project

Welcome to EaglePedia - the official documentation project for the Eagle Project and affiliated technologies. EaglePedia is the definitive source of information for members and visitors to read about and learn how AMSAT OSCAR - Eagle will revolutionize amateur satellite operations. You will be able to view official design documents, see the status of Eagle subsystems and components, and learn about the people behind Eagle.

Getting Around in EaglePedia

EaglePedia is organized by "Category" of information, and each category in EaglePedia contains a list of both the pages assigned to that category and any subcategories it may contain. The easiest way to see the categories and subcategories in EaglePedia is to start with the [Eagle Project Index](#) link in the "navigation" sidebar or click on the header for this section.

You will then see individual entry points for currently defined categories and subcategories. Entry points in **blue** (indigo if you have already visited that page) indicate the link is valid or at the least contains a template. Entry points in **red** indicate the link currently contains no information.

Eagle Project Information

The Eagle Project Index is a hierarchical tree of links to Eagle's systems and subsystems along with links to administrative information. This is the best place to start for most people.

News From the Bridge is a periodic newsletter from the Eagle Project Manager. It usually contains the latest information and announcements about Eagle Team activities.

The following locations are also popular:

- About Eagle will help you learn about Eagle in a general way
- The Eagle Functional Requirements will acquaint you with the goals for Eagle's design
- The Eagle Charter defines the goals of the Eagle Team
- The EaglePedia FAQ provides answers to frequently asked questions

site navigation

Popular Entry Points

- Eagle Main Page
- About Project Eagle
- Eagle Project Index
- Eagle Requirements
- RF Communications
- Mechanical
- Electrical

Informational Pages

- The EaglePedia FAQ
- New pages
- Most popular pages
- Eagle Calendar
- Help

Other Locations

- Return to AMSAT

Contents [hide]

- Getting Around in EaglePedia
 - Eagle Project Information
 - Additional Entry Points
- Donating to Eagle
- Contributing Content to EaglePedia
- The EaglePedia Logo
- Administration
- Copyright Information
- Acknowledgements



Eagle

AMSAT BoD Approves Communications Payloads

- A U/V linear transponder
 - » System design has a goal that it be usable over 75% of the orbit by an AO-13 or AO-40 capable ground station.
- A L/S1 linear transponder.
 - » An AO-13 or AO-40 capable ground station will be able to use this payload.
- A low rate text message system, like SMS.
 - » It will operate on U/V-bands and be usable over 75% of the orbit by a small terminal on the ground.
- These transponders will be implemented using Software Defined Transponders (SDX).



Eagle

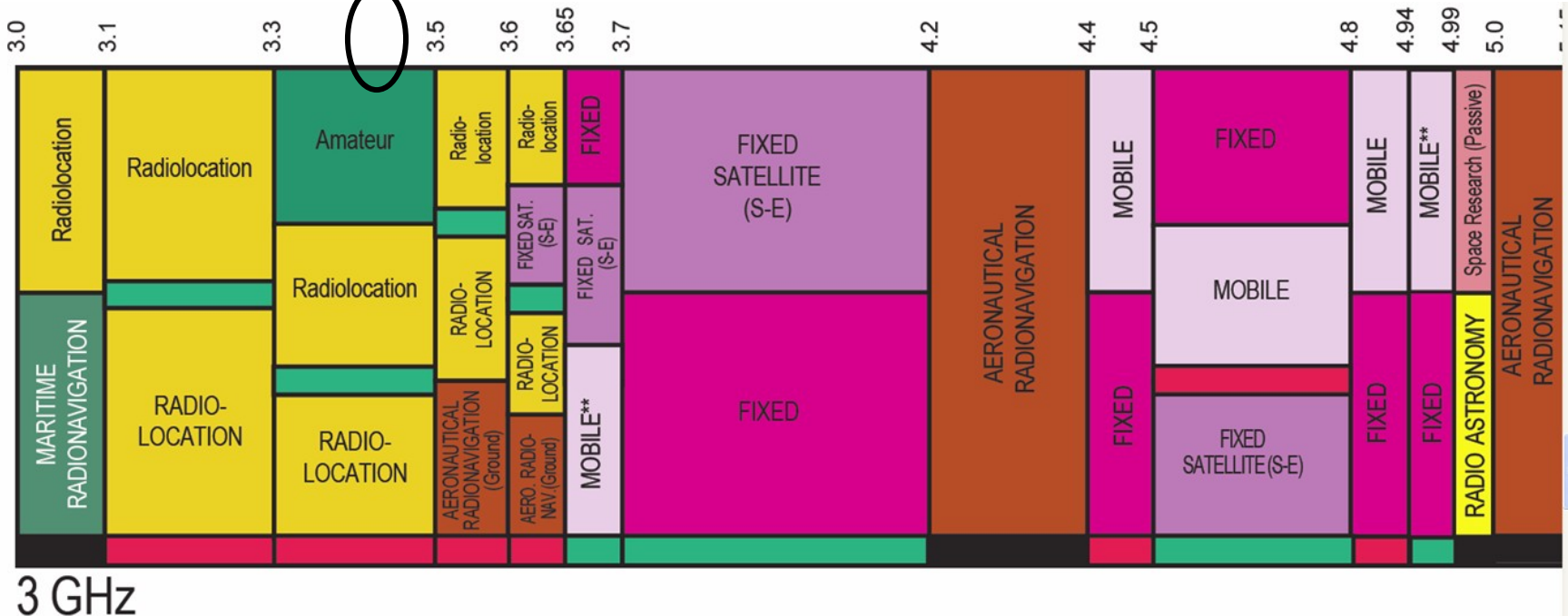
AMSAT BoD Approves Communications Payloads

- An Advanced Communications Payload (ACP).
 - » Using advanced signal processing and RF techniques.
 - » Voice communications on S2-band (3.4 Ghz) uplink and C-band (5.8 Ghz) downlink using a single 60cm dish. The satellite antennas will be electrically steered to reduce spin modulation and allow use over 75% of the orbit.
 - » An additional, fix-pointed, uplink will be available at L-band. This L-band uplink will require a separate uplink antenna at the ground station.
 - » High rate data communications, such as streaming video, using a 2m dish on S2/C bands.
- AMSAT will develop and make available an affordable ground segment for the ACP System.

The S2 Band

3400–3410 MHz Band

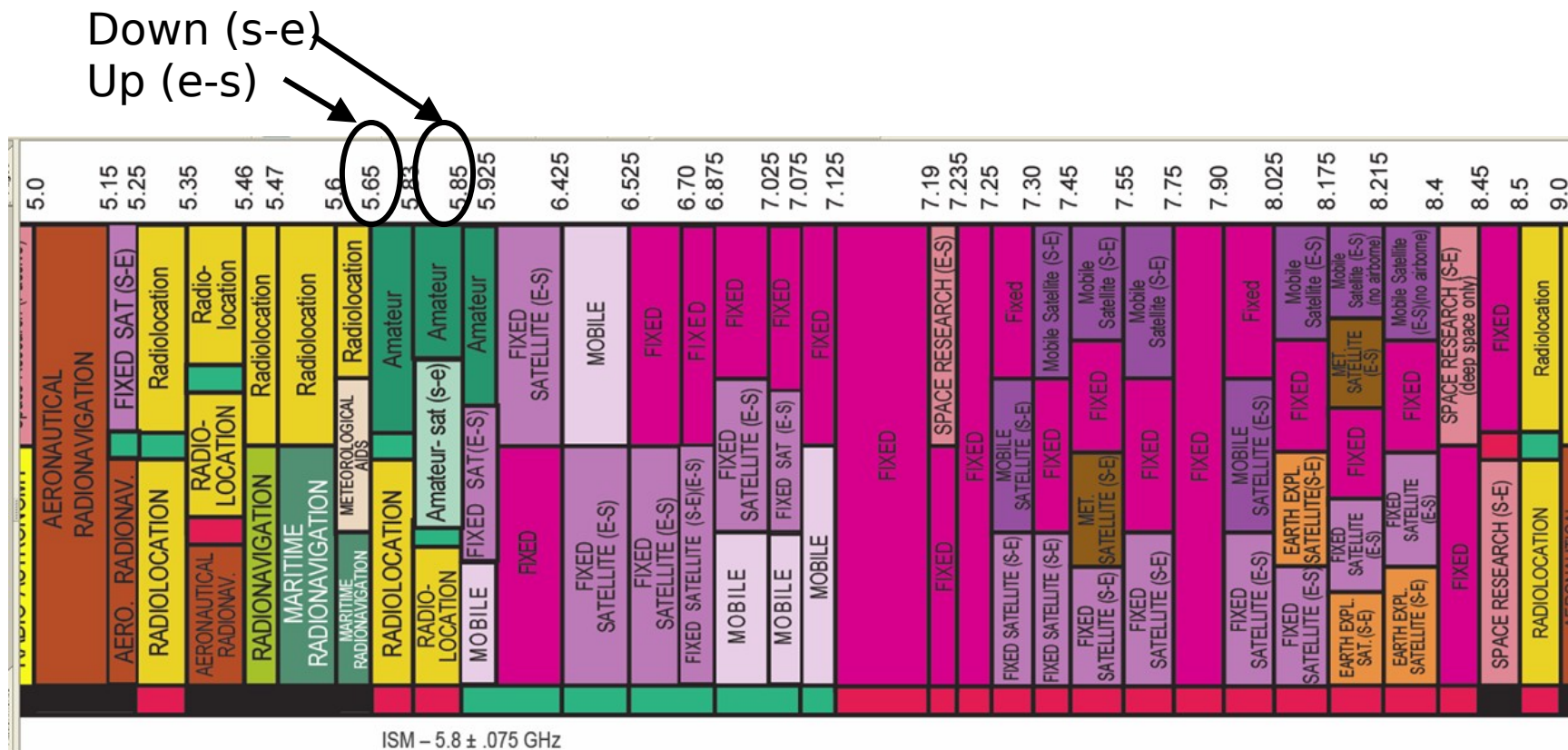
Up & Down
(s-e) and (e-s)



Note: We planned to use this band for Earth to Satellite on this payload
But this may change

The C Band

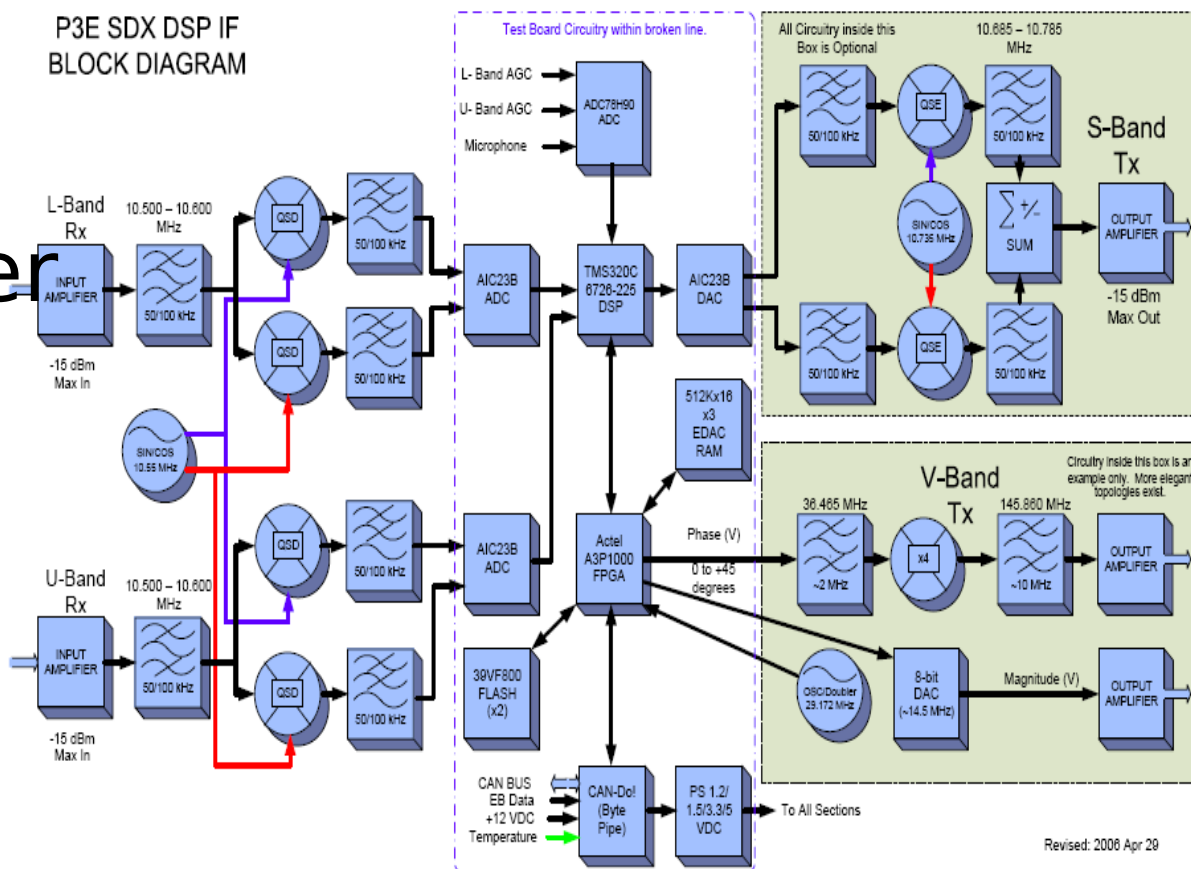
5650-5670 MHz Up, 5830-5850 MHz Down



*Note: The chart fails to show the Amateur Sat (e-s) allocation but it is there!
We planned to use this band for Satellite to Earth on this payload
But this may change*

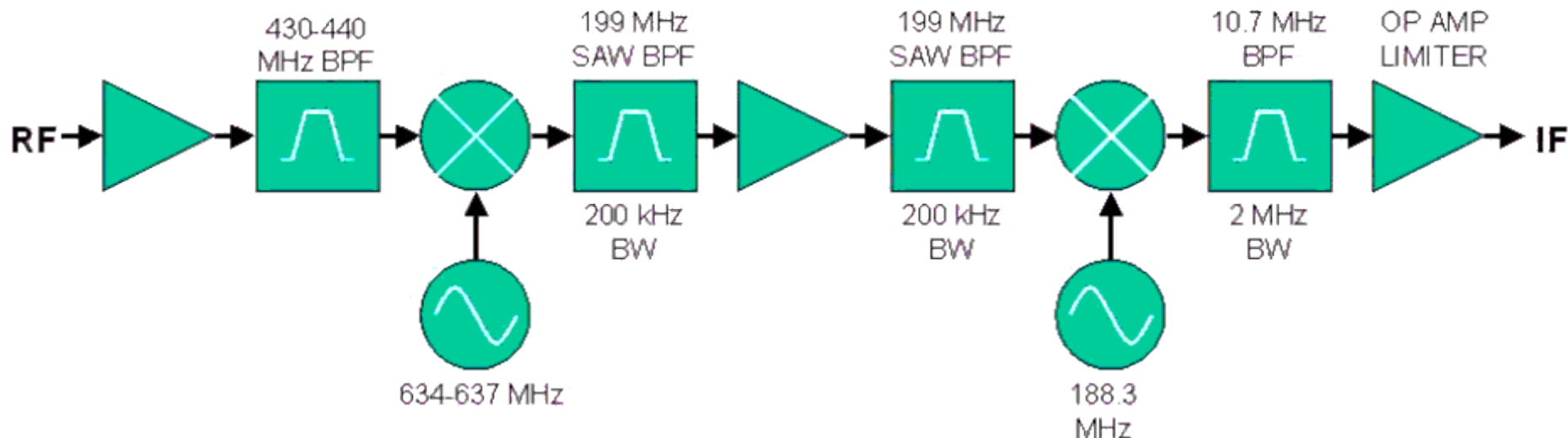
Approach to Linear Transponders

- Software Defined Transponder
- Looks Complex
- Complexity is worth it

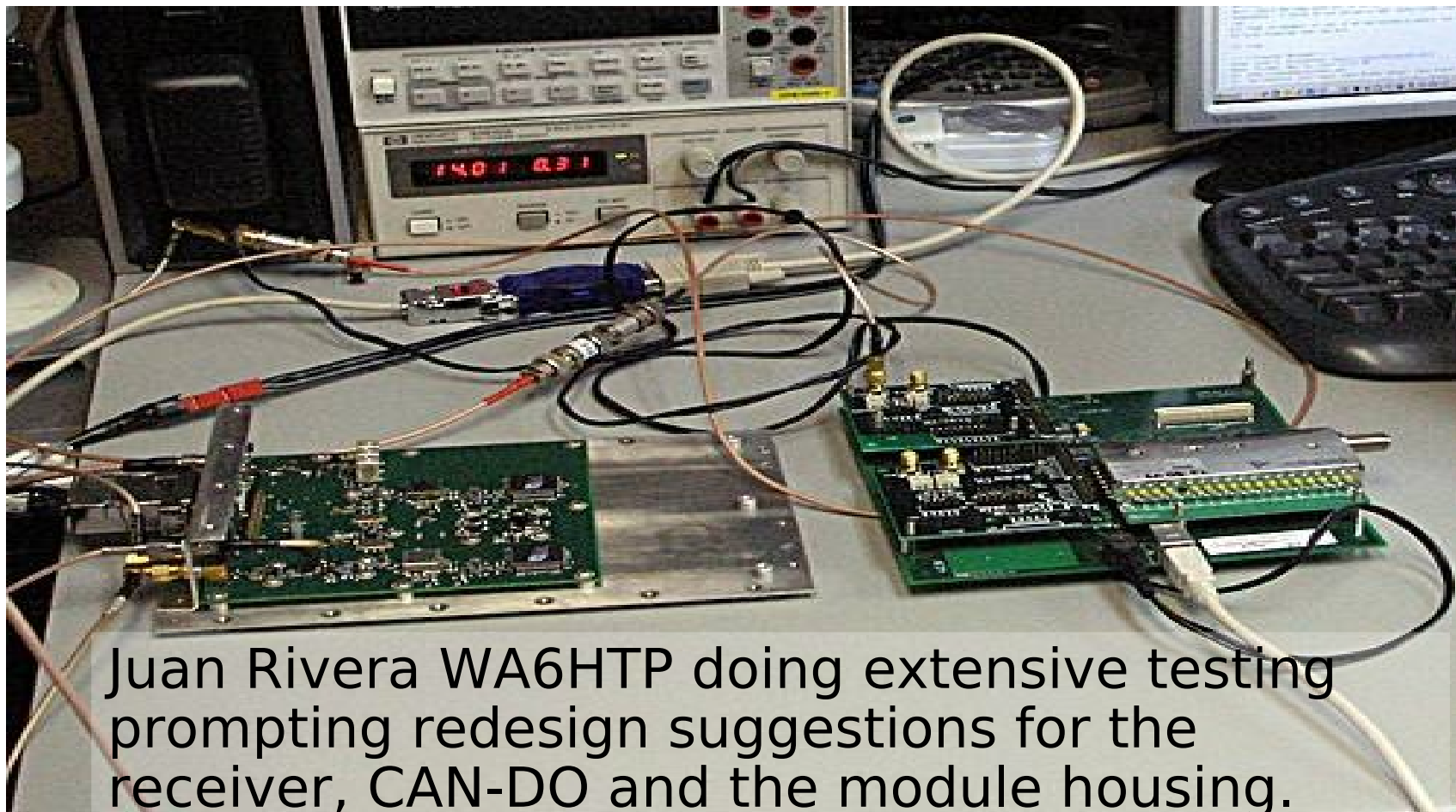


KD6OZH Designs a 70cm RX

- John Stephensen, KD6OZH designing the 70 cm RX.
- Large dynamic range compared to all previous RX for AMSAT to combat PAVE PAWS radar interference
- Some frequency agility.
- Low phase noise oscillators to allow for low baud rate text message support from hand held devices.



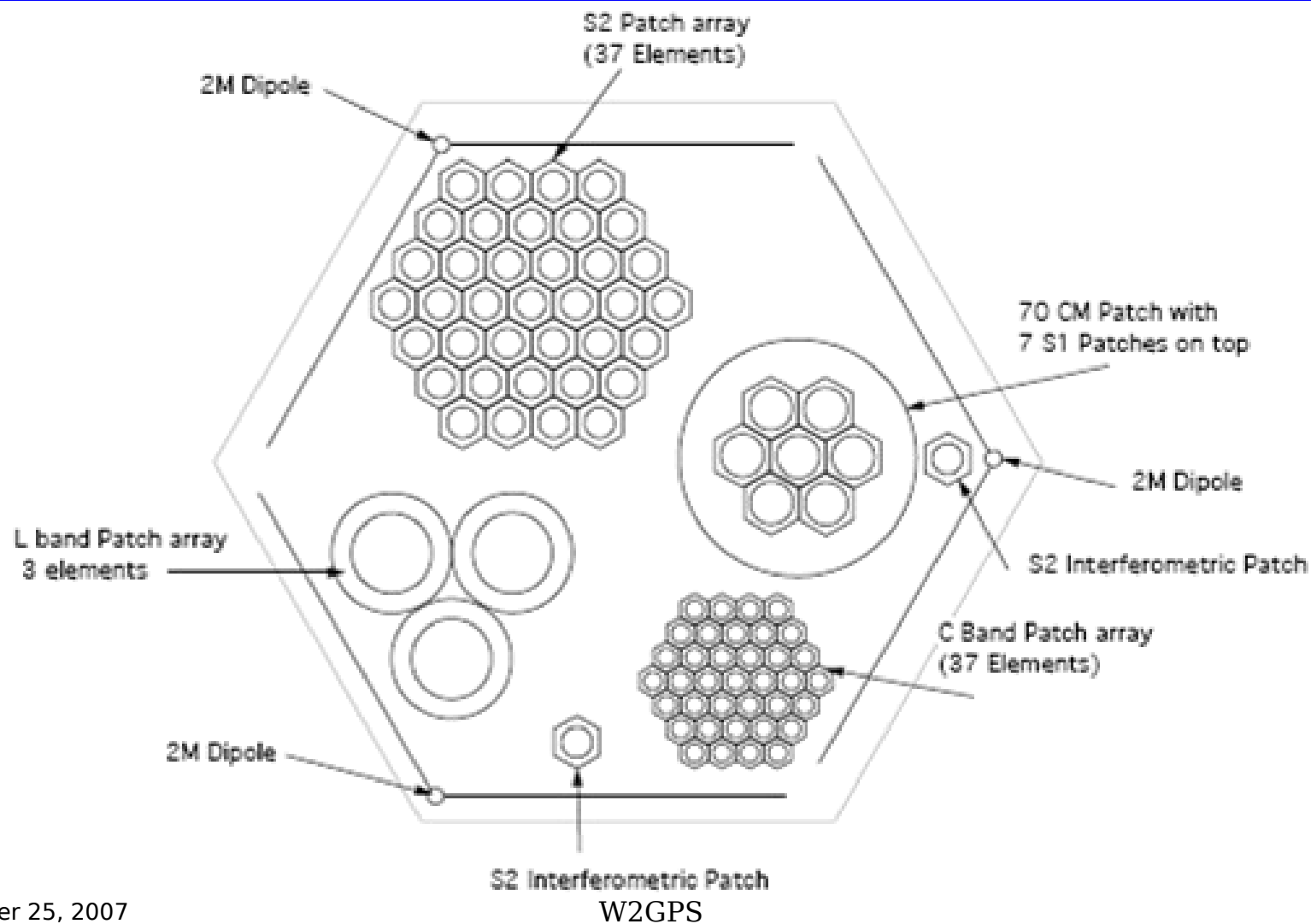
The Build and Test by WA6HTP



Juan Rivera WA6HTP doing extensive testing prompting redesign suggestions for the receiver, CAN-DO and the module housing.

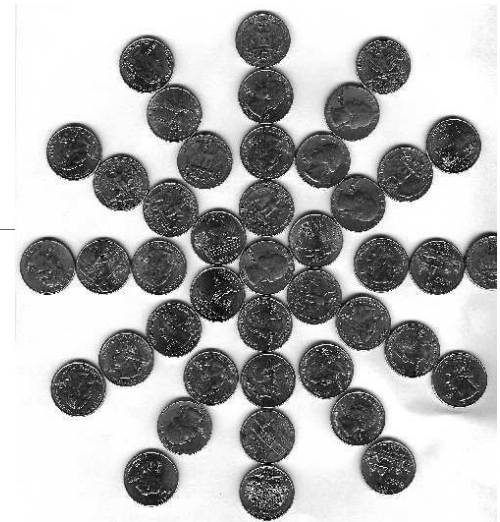
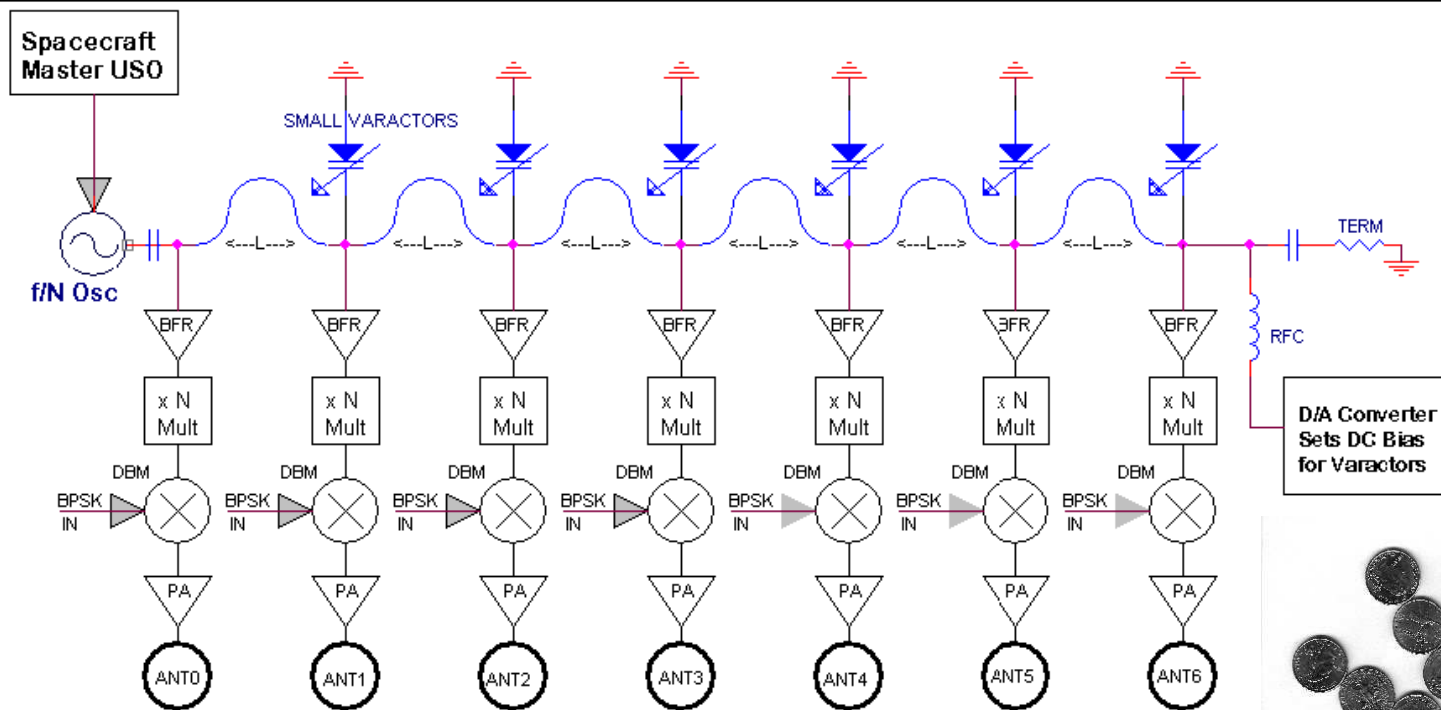
Proposed Eagle Antenna Array

One Possibility



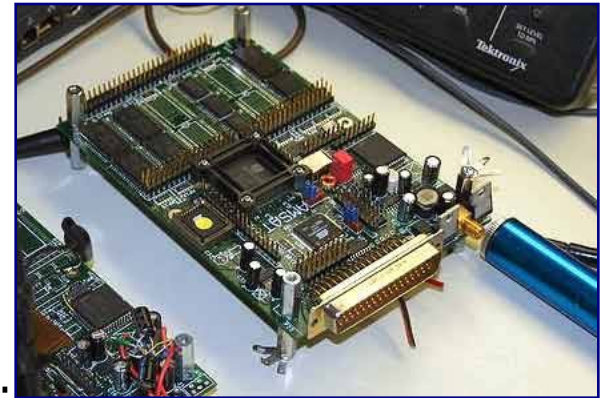
Steered Arrays for 3.4 GHz and 5.8 GHz

by Dr. Tom Clark, K3IO



Eagle Electronic Payloads

- IHU-3 Housekeeping computer – will be flown first on P3E in 2006/7
- All modules connected via the CAN bus
- All radios will be Software Defined
 - » 50KHz U/V (mode B) passband
 - » 2 - 100KHz L/S and U/S passbands
 - » C Band (5GHz) Wideband Digital (digital voice and data) that will be in-band, meaning both transmit and receive will happen from one small antenna
- U/L Command uplinks
- Engineering and General Beacons on all bands





Eagle Possible Orbits

- Orbits will depend on launch vehicle (Atlas V from the Cape is most desired)

Atlas V Launch Profiles

Mission	Apogee Km	Perigee Km	Inclination (degrees)
AV-001	45,856	314.9	17.83
AV-002	85,457	312.2	17.06
AV-003	35,843	3,790	17.54
AV-004	90,553	441	20.83
AV-005	35,786	4,798	18.02

Delta IV Launch Profiles

Mission	Apogee Km	Perigee Km	Inclination (degrees)
DSCS B6	35,593	238.4	25.5
DSCS A3	35,597	237.6	25.5
Eutelsat	35,771	540.4	13.49

Ariane V Launch Profiles

Mission	Apogee Km	Perigee Km	Inclination (degrees)
v160	35,798	590	7.00
v155	35,929	579.3	5.49
v153	35,855	578.9	5.49
v140	36,032	863	2.02



Educational Outreach

University Mentors, Education & Satellites

AMSAT is working with several groups to promote the education and training of the next generation of engineers and scientists through hands-on satellite design and construction projects.



Credit: FASTRAC



AMSAT-NA Considering Establishing AMSAT Summer Camp



Tony Montiero, AA2TX, assists 5th Grade Students building S-band antennas



New AMSAT Lab in Pocomoke City MD

Site Survey, October 2006



October 25, 2007

W2GPS



New AMSAT Lab Move-in January 4-5, 2007



October 25, 2007

W2GPS



New AMSAT Lab

Move-in January 4-5, 2007



October 25, 2007

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New AMSAT Lab

Clean Room being Erected, April 2007



October 25, 2007

W2GPS



New AMSAT Lab

Nearly Finished Clean Room, April 2007



Bob Davis KF4KSS
A Job Well Done!



New AMSAT Lab Taking Shape, Sept 2007



Machine Shop



New AMSAT Lab Taking Shape, Sept 2007

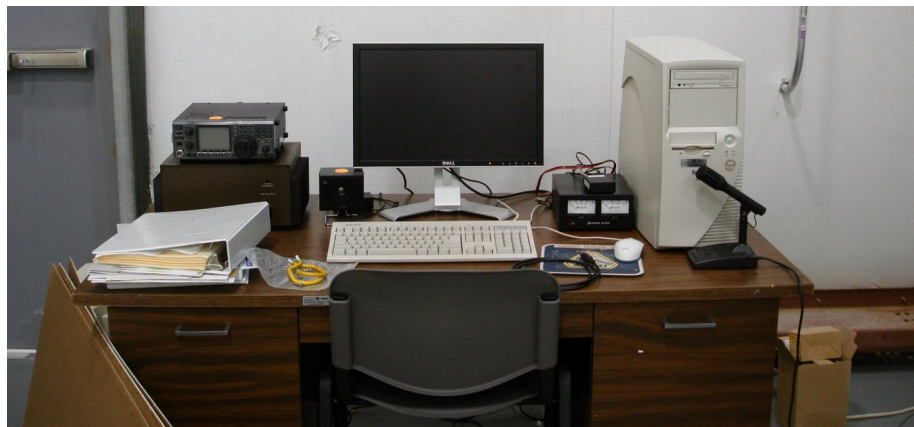


October 25, 2007

W2GPS



New AMSAT Lab Taking Shape, Sept 2007



AMSAT will have
a remote
controllable
ground station at
the lab with a
tower and large
antennas.



October 25, 2007

W2GPS



AMSAT Needs YOUR Help



To achieve AMSAT's goals we need new members, volunteers, and money

- Join the Field Ops Team
- Encourage your friends to join AMSAT
- Represent AMSAT at local events
- Send an Annual Contribution to AMSAT
- Join the President's Club
- Contact any of the officers or BOD Members
- Spread the news on AMSAT
 - » Read the AMSAT News Service (ANS)
 - » Read the AMSAT Journal
 - » Use the AMSAT Website (www.amsat.org)
 - » Talk up AMSAT